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## THE CLASSIFICATION OF THE POPULATION ACCORDING TO INCOME

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An accurate statement of the annual book<sup>1</sup> income of an individual will, on the average, throw almost as much light upon his living conditions and relations to society as could be found in a thousand-word description of his immediate environment. Given that one bit of information, we can make a fairly accurate estimate of the house he lives in, the food he eats, the clothes he wears, the comforts and conveniences that he possesses, the amount that he has traveled, the education that he has received, and the social circle in which he moves. While it is true that our estimate will doubtless be in error on some of these points, no other single statement would furnish even a tithe of the information thus presented. It is surprising also how little the accuracy of our estimates will be affected by geographical location. True, one naturally expects those residents of the same vicinity who have approximately equal incomes to live in about the same degree of comfort or luxury. But what about persons of similar income who live in localities distant from each other? In such cases a limited amount of information concerning the differences in price level in widely separated regions doubtless will be necessary if the effects of income are to be correctly interpreted, but, granted this knowledge, we can still draw from that mere numerical statement of income a fairly accurate portrayal of existing conditions. Whether the individual in question lives amid the snows of the Klondike, in the forests of Guatemala, or in the heart of New York City, we can be fairly sure that if his income is large his surroundings are, in general, comfortable; while, if his income figure represents poverty, we can be equally certain that no matter what his place of abode he is suffering many hardships.

<sup>1</sup> Book income is what is usually less accurately referred to as "money" income. Evidently, income consisting of commodities, increased assets, etc., though credited on the books in any correct accounting system in terms of money value, scarcely fits accurately under the title "money income."

Since one number, consisting of three or four figures, may represent such a mass of information, it becomes a matter of the greatest moment that every digit in that number be as accurate as possible; otherwise the conclusions drawn must inevitably be liable to error. Obtaining such accurate income statements is, however, a matter of very considerable difficulty, and it therefore seems worth while to consider the issues involved in the collection of reliable statistics of income and in the classification of the population upon the basis of economic status.

The need for such accurate classifications is hard to exaggerate. It seems clear that the relation existing between income and sickness rates is so close<sup>1</sup> that, until the income factor has been dealt with successfully, it is almost useless to attempt statistical studies of the effect of other forces upon health. Economists, statisticians, and sociologists are all interested in studying the distribution of income in the United States today in comparison with other times and other countries. Reformers usually consider income distribution a matter of cardinal importance. Statesmen are compelled to take cognizance of a matter generally believed to be of such vital moment.

While the present writers had long been interested in questions concerning the distribution of income, the problems connected with the collection of income statistics and the classification of incomes were brought to their attention more forcefully than ever during the progress of an investigation which they made under the direction of Dr. Joseph Goldberger for the United States Public Health Service concerning the economic life of the inhabitants of twenty-four South Carolina cotton-mill villages.<sup>2</sup>

At first thought one would be inclined to believe that the problems met in such a study would cover a very narrow range and would therefore be of interest only to a few special students of labor problems. As a matter of fact, however, the population

<sup>1</sup> See Sydenstricker, Wheeler, and Goldberger, "Disabling Sickness among the Population of Seven Cotton Mill Villages of South Carolina in Relation to Family Income," *United States Public Health Reports* for November 22, 1918, Vol. XXXIII, No. 47.

<sup>2</sup> See the *United States Public Health Reports* for November 26, 1920.

studied received income of all the types commonly dealt with by economists. While a large part of the discussion, therefore, deals with but one class of people, the principles enunciated, although perhaps applying with maximum force to the laboring class, are nevertheless, as a rule, general in their application and hence are of interest to all students of income.

Observations made in 1916 during the progress of the field work led at least one of the investigators (E. S.) to believe that a fairly accurate rating of each individual as to economic status was essential to the solution of the problem at hand, namely, that of determining the forces giving rise to pellagra. Yet, despite the urgent demand for accurate information in this field, no thoroughly scientific method of obtaining an accurate classification of the population upon an income basis could be discovered in existence. It therefore became necessary to devise a plan which would accomplish this end. When, at the beginning of 1917, the other of the present writers (W. I. K.) joined the staff, the fundamental methods of procedure had already been put into practice. During 1917, however, a much more elaborate field study was carried on. It covered about 4,000 families, a number amply sufficient to give statistical regularity to the data obtained therefrom.

Each family was visited from two to five times during the year. At these times complete records, covering approximately the two months preceding the visit, were secured concerning earnings, unemployment, food supply, income from sources other than wages, etc. These schedules were edited once in the field and later twice in the office. The necessary computations were next made, all operations being carefully checked. During the process of working up the data obtained during this 1917 study, the general plan of procedure used in 1916 was remodeled and refined, improvements being made in numerous details and several errors in the original methods being eliminated. Much time and thought were required to devise, test, and reconstruct the rules for dealing with the numerous practical problems which constantly arose in the course of the work. Since numerous economists and statisticians are now engaged in studies of income and distribution, the authors feel that a statement of the particular difficulties which were encountered,

the ways in which they were met, and the devices that were found essential in arriving at a bona fide classification of a population upon an income basis may perhaps save to others much of the time necessary for deriving logical original solutions of the problems which may confront them in their work.

#### PRACTICAL PROBLEMS ARISING IN CONNECTION WITH THE COMPUTATION OF THE NET FAMILY INCOME

It is clear to every thinking person that income in its relation to welfare must be considered as a phenomenon pertaining to families rather than to individuals, since normally all the individuals within a single family are about equally well off without regard to their personal earning power. First of all, then, it is necessary to arrive at a definite understanding as to what is meant by the term *family*. A family, considered from the point of view of income, has nothing to do with blood relationship or with the place where the individuals eat or sleep. The boy away at college, if he is supported by his parents, remains a part of the economic family. On the other hand, the boy who boards and lives at home but pays for his food and lodging on the same basis as a stranger, reserving the rest of his wages to spend as he pleases, is just as clearly not a member of the economic family. The unrelated orphan who makes his home with the family is as truly a member of the economic family as is a son or daughter. In short, *an economic family includes all persons contributing the bulk of their income to a common family income stream or depending mainly upon this stream for their support.* Millions of such families consist of only one person, usually an unmarried man or woman having no immediate dependents, and, in turn, not depending upon others for support.

The book income of a family may be thought of as a stream flowing continuously but varying somewhat in volume, not only from year to year, but even from day to day. These variations mean that the average income for one period is not likely to be exactly equal to that for another period. For detailed studies, therefore, it may be necessary to estimate the income season by season; for most purposes, however, a correct record of annual

income is preferable. The occurrence of large irregular or seasonal variations, however, makes it entirely out of the question to estimate annual income by the frequently attempted plan of using the income for a single week or a single month as typical of that for the entire year. A much more adequate method of sampling is essential if accurate results are to be obtained. A practicable method of approximating the income of working-class families is to ascertain the income of each for from four to six one-week periods, these periods being spaced at somewhat equal intervals throughout the year. If families having much income from property are to be dealt with, the sampling method is likely to prove a failure, as the bulk of the income may arrive on a few definite dates, and months may pass in which actual receipts are almost non-existent. The choice of the correct time interval and the method of sampling best adapted thereto require, then, a careful consideration of the ends to be accomplished.

If it is desired to determine the income status at some special season, as, for example, the summer months, it is not always sufficient to consider receipts coming in during the specified period only. A farmer, for instance, may sell his entire crop on November 1, and live on the proceeds throughout the remainder of the year. Evidently his family cannot reasonably be assumed to have zero income during the summer. Some logical system of adjustment is necessary if they are to be rated correctly in other months than November. Several possible courses may be followed. For example, the income for July might be figured as one-twelfth of the entire value of the crop. The summer living conditions, however, will be portrayed more correctly as a rule, if the July income is assumed to be one-fourth of the crop money remaining unspent on July 1, for it is this supply of cash which most tends to limit the scale of living of the family during the four months before the date when it is expected that the next crop will be sold.

Income arises from many different sources and, in estimating each particular kind of income, certain difficulties peculiar thereto are likely to be met. Some of the problems of this nature which arose during the course of the investigation and the methods of solving them finally determined upon are enumerated below.

1. A married woman may engage in factory work, meantime employing a servant to keep house and care for her children. In such instances it is most logical to consider the servant's wage and board as business expenses to be deducted from the wife's earnings. If this is not done, families of this type will be given an income too high compared to that of other families not hiring servants; for in many instances, while the gross earnings of the wife are considerable, the net gain in income is slight, the chief reason for the wife's working being, not the money gained, but the fact that she prefers factory work to housekeeping.

2. Entrepreneurial operations are often thought of as being confined mainly to the ranks of the well-to-do, but as a matter of fact, the laboring families studied in this investigation frequently engaged in undertakings such as draying, livery work, running a barber shop, selling books or machines, conducting a small mercantile enterprise, trading in live stock, farming, etc. In every such instance the operating expenses, including hired labor, interest on the investment, up-keep and depreciation of machinery and live stock used, taxes, insurance, etc., should be deducted from the gross receipts in order to ascertain the net profits. If the family residence is partly used for housing hired workers, conducting mercantile operations, for office purposes, or the like, a suitable fraction of its rental value should be charged against the business undertaking in question.

In case the enterprise requires the joint co-operation of several members of the family for its success, the net gain or loss should be figured as part of the family income and not accredited to the head of the household only. If income is being classified according to its nature, receipts of this sort should never be grouped with wages or salaries received. Such receipts, however, may frequently be ascribed to certain individuals as profits due to their personal efforts.

3. A worker may be engaged in an occupation requiring some unusual outlay in order to hold the position; for example, the location of the work may be such that the expense for transportation is far above normal; unusual clothing may be required; the employee may be called upon to furnish special tools or supplies, as, for instance, when miners must buy their own blasting powder;

and many other similar instances will doubtless occur to the reader. In all such cases the earnings, before being added to net income, should have deducted from them any excess of outlay above that customary for the working class in general in that vicinity. Only by so doing can the net earnings and income be placed upon a basis comparable with similar figures compiled for workers engaged in other lines of activity.

4. In calculating the total family receipts from the earnings of wage-earners it is imperative to know, not only the daily wages, but also the number of days actually worked by each member employed. To secure this data from the employers is a very difficult task, because each wage-earner may work for a different employer, and any one worker may change his job or place of employment several times during the period of study. The investigator, therefore, is almost compelled to get his information from some member of the family—usually the housewife. The general objection to this method has been that the information has not been considered accurate enough to be of great value, for it has been assumed that lack of knowledge and the desire to make either a bold front or an appeal for charity would together seriously vitiate the information given.

A statistical test of the facts does not tend, however, to corroborate this assumption. The actual employment records of 1,486 cotton-mill employees were compared with the statements as to their time idle made by members of their respective families. On the whole, the correspondence is close, the mill records showing only 13 per cent more unemployment than that reported by the housewives.

A similar test was made with respect to earnings, the family statement concerning the wages of 1,557 employees being compared with the mill pay-rolls for exactly the same list of persons. The error of the average derived from the family statements was only 2 per cent, and the distribution of earnings, as shown by data from the same source, did not differ at all widely from that obtained from the mill pay-rolls.

In the case of the family statements, the unemployment records were obtained for the preceding two calendar months and the earnings for the immediately preceding week only. Both studies

dealt almost entirely with members of the households of the informants. The information required was thus relatively simple in nature, and this simplicity made the fact that the informants usually were very poorly educated a handicap of less importance than would have been the case had the facts desired been complex in their nature. Nevertheless, the higher degree of education possessed by other classes of the working population would doubtless make possible a still greater degree of accuracy in answering the questions. Perhaps it is unsafe to infer, however, that all groups of the population are, on the average, as frank and truthful in giving information as are the South Carolina mill operatives. However, it is not probable that the differential would prove great enough to cast material doubt upon the approximate reliability of statistics gathered from the families affected. Until concrete evidence of the untrustworthy character of some class of the population is brought to light, it seems safe enough to assume that, on the whole, family statements concerning unemployment and earnings may be accepted as accurate enough for most practical purposes if the period covered by the inquiry is not longer than two months. It seems probable, on the other hand, that an effort to collect by this method records for the entire preceding year would be very much less successful, since, in this case, faulty memory would make the reports of unemployment, and probably the reports of earnings, largely unreliable. The conclusion, therefore, is that earnings records should usually be collected directly from the families of the wage-earners, but that accurate annual records can, as a rule, be secured only by making several visits at regular intervals. The information obtained for the various periods can then be combined to form a satisfactory estimate for the year.

5. Except among the wealthy, gains from boarders or lodgers frequently form a noticeable share of family income. Many investigators have added the entire money payments from these sources directly to the family income, thus introducing a most obvious error, for to obtain the net income, it is, of course, essential that the proportionate cost of food, fuel, light, house rent, laundry, and perhaps water, telephone, gas, etc., be deducted from the gross receipts. The seriousness of the failure to make such deductions

is apparent when we consider that in many families gross receipts from boarders may constitute a sum several times as large as all the remainder of the family income; while, as figures collected by the writers from the cotton-mill villages of South Carolina show the net profits from keeping boarders average less than one-third of the gross receipts.

6. Many families keep poultry, swine, or cows. In such instances the gross receipts from live stock evidently must include not only sales but also the money value of all meat, milk, butter and eggs used by the family; and these products must be evaluated at the market prices rather than at the costs of production, for, if not produced at home, they would usually be bought from others at the market prices. In cases in which there is reason to believe that, if not produced at home, the use of the article would be dispensed with, it is legitimate to deduct the expense of marketing from the market price.

If calves are raised or sold for veal, the value represented by their growth or by their sale price must not be overlooked in counting up receipts.

The live-stock account must evidently be debited with all feed purchased, with all salable home-grown products fed, and with new stocks bought, and the net increase of inventory must be counted as income.

7. Horticultural products form a part of the income of many families. Just as in the case of animal products, the market value of the fruits and vegetables consumed by the household or fed to live-stock must be added to the sales in order to ascertain the total gross receipts. Deductions must then be made for the value of seeds, roots, trees, etc., planted and for hired labor, fencing, machinery, insecticides, fertilizer, city water, etc., used in producing the crop.

8. Losses sometimes occur in every account, though more rarely in the wage account than elsewhere. A wage loss may occur, for example, when the wife spends more than her earnings as a wage-worker in employing a servant to perform the household duties which she has forsaken. Evidently losses of any variety must be counted as negative net income and must under no circumstances

be omitted when totals, averages, or classifications of income are being made.

9. Donations received must be credited to the net family income, but donations made to others cannot, in turn, be deducted therefrom, as they are supposed to be purely voluntary expenditures of the net income. If it appears, however, that two families are really conducting trade under the guise of exchanging gifts, then both receipts and expenditures should be entered under the caption of "Trade" rather than under the head of "Donations."

#### CORRECTING INCOME FOR CHANGES IN THE PRICE LEVEL

The problems listed above, however, are relatively simple as compared to those which are occasioned by the recent revolutionary changes in the price level. It is commonly desired to compare incomes from year to year to see whether the economic welfare of a certain class of families is or is not on the upgrade. A comparison of book incomes evidently fails to answer the questions involved; hence, it is necessary to fall back upon incomes in purchasing power. Such incomes are, by definition, book incomes converted into terms of the commodities which the given class of receivers generally wishes to purchase. Every change in the price level and every business transaction gives rise to a new series of problems. It would be beyond human power to straighten out accurately the intricate maze of such difficulties arising from the numerous transactions engaged in by an active business man, but, nevertheless, a few broad rules may be laid down which will assist somewhat in reducing annual book incomes to incomes of purchasing power, thus making comparisons between different years more feasible.

The first essential is to compute or obtain a reliable chronological series of weighted average index numbers covering approximately the list of commodities that are commonly purchased by the class of persons to be considered. An average index should be available for the beginning of each year of the period studied, and another should be on hand showing the average prices for each entire year. Such an index is usually obtained by averaging the index numbers for the various months of the year.

The net income of any business during any given year may be found by subtracting the net resources at the beginning of the year from the net resources at the end of the year, adding to the remainder the amount of income withdrawn during the year by the owners, and subtracting from the sum the value of new investments of assets secured outside the business. If, however, the price level has changed during the year, it is evident that a dollar's worth of net resources at the end of the year is not worth the same as a dollar's worth at the beginning of the period. Suppose, for example, that the price level rose 50 per cent during the year, and that a piece of property was correctly valued at \$10,000 at the beginning and \$14,000 at the end of the year. The apparent gain of \$4,000 was, then, wholly a fiction. That such is the case is clearly seen if the values are both reduced to the standard of the base year. This is accomplished by dividing the net resources at the beginning of the year by the average index of prices at that date, and, similarly, the net resources at the end of the year by the price index at that time. If the price-level index stood at 100 at the beginning and 150 at the close of the year, then the relative values of the property in purchasing power at the two dates were respectively \$10,000 and \$9,333 showing a net loss of \$667 at basic prices.

The following simple method will in most cases give, with approximate correctness, the net income in purchasing power, although irregular investments or withdrawals of assets by the owners will usually introduce errors of some slight importance.

1. Divide the net resources at the beginning and at the end of the year by the respective price-level indexes at those dates. In this manner net resources are converted to their values at the prices prevalent at the base date.

2. Subtract the corrected resources at the beginning of the year from the corrected resources at the end of the year.

3. To the remainder add algebraically the quotient obtained by dividing the total amount withdrawn by the owners during the year by the average price-level index for the entire year.

4. From the sum just derived, subtract the quotient obtained by dividing the total amount of additional outside assets invested

in the business during the year by the average index of prices throughout the year. The result will show roughly the net gain or loss from the year's business reduced to the price level of the base year. If the accounts for each year are treated similarly, it will be possible to tell whether net income is increasing or diminishing as time passes.

#### THE CLASSIFICATION OF FAMILIES ACCORDING TO INCOME STATUS

During the progress of the investigation into health conditions in the cotton-mill villages it continually became more apparent that an accurate classification according to income of the population studied was essential to a successful solution of the problems. The net income of each family was computed according to the rules formulated in the preceding pages. This part of the work, however, while very laborious required, in the main, not new statistical devices, but merely modifications of accepted principles of accounting. When, however, it came time to divide the families into income classes, real difficulties arose. These difficulties centered about the fact that the families studied differed widely in the numbers of persons which they respectively contained and also in the ages and sexes of these persons.

A hasty review of the literature on the subject comprising both government reports of numerous nations and the works of private investigators failed to reveal a single instance in which families had been scientifically rated according to size. In most instances a family had been considered as one unit whether it contained one or a dozen members. In other cases all families had been discarded except those falling between certain definite limits, as, for example, when the United States Bureau of Labor selected certain "normal" families consisting of a husband and wife with no children over a certain age, or even with only certain numbers of children of rather definite ages. Evidently this system of discarding all families not meeting the requirements results in reducing greatly the number of families that can be studied. Since the work in hand required the inclusion of the great majority of the families in the villages, no methods entailing such wholesale rejections could be considered.

The most casual consideration will convince any intelligent person of the absurdity of placing in the same income class two families, each having an income of \$1,800 per annum, when one family consists of a single man and the other of a man and wife with ten dependents. The plan of discarding all families outside of certain limits is evidently also a most awkward and unsatisfactory device, for if the interval remaining between the limits is narrow only a few families, perhaps far from typical, can be selected, from any group, while, on the other hand, if the interval is wide the families included must be far from homogeneous, and the results will therefore not be clear-cut.

A crude way of meeting the difficulty which at once suggests itself is to divide the family income by the number of persons in the family, thus arriving at the per capita income. This method, while doubtless a slight improvement over that of considering all families equal, is nevertheless subject to a high degree of error. It is manifestly absurd to assume that a family with four daughters in high school and college can live as well on the same income as can a family with four children under ten years of age; yet, the per capita incomes of the two families would be identical. Evidently if thoroughly reliable and useful classifications of the population according to income are to be arrived at, more scientific methods than those just mentioned must be used.

The fundamental principle upon which such a plan must be based is that that family will be considered as having the best economic status which has the most income in proportion to its *requirements*. For this particular purpose the term requirements will be arbitrarily defined as those things which the members of the community in general consider to be the normal kinds of consumption goods to purchase. According to this rule, if, on the average, men in the locality spend twice as much as women for clothing, then their requirements will be assumed to be twice as great as those of women. Following this idea further, if we know the average expenditures of persons of each sex at different ages, we can by addition easily find the average requirements of any given family. By dividing the actual income by the requirements the relative standing of the family will be obtained. The foregoing

are the assumptions and the principles of classification used, though the actual mechanical procedure is varied somewhat in order to give greater clarity to the meaning of the final results.

The first thing necessary, then, in determining the requirements of males and females of different ages was a study of the expenditures as they actually occurred. Enumerators therefore canvassed about three hundred families in order to ascertain the amounts actually spent for each member of every family for thirty classes of common articles generally purchased for individual use. About half of the records, since they appeared to be more or less faulty, were rejected, leaving 140 schedules—representing 672 individuals—which were believed to be sufficiently accurate to give dependable results. Using the data obtained from the 140 schedules it was found possible, by aid of a modified system of moving averages, to secure a curve for each sex showing the total amounts spent, on the average, for the individual benefit of persons of different ages in obtaining clothing, drinks, tobacco, amusement, education, medical and dental services, etc. The actual expenditures were next converted from an absolute to a relative basis. This was done by taking the highest point of the scale for males as a base and then dividing the expenditures for each sex at every age by this number (which happened to be \$100.79). The resulting quotients represent, for the respective sexes, the relative expense of obtaining, for persons of various ages, articles for individual use. The advantage of converting the scales into a relative form is that then they can with ease be legitimately compared with or added to the relative scales for classes of families having widely different incomes. The combination of the absolute scales is attended with so much greater difficulty and so much larger possibility of error that it can scarcely be attempted with safety.

But articles purchased for individuals constitute only about a third of the family's entire outlay. Food, which is the most important item and takes nearly half of the mill family's income, is purchased, as a rule, for the family table and so cannot be apportioned to the different individuals as easily as can clothing or dental bills. In this phase of the problem, however, material assistance was at hand in the work of the physiologists. For a

long time they have studied the food requirements of individuals in calories, and the Atwater scales, showing the relative food needs of persons of both sexes and of various ages, had been worked out

TABLE I

RELATIVE EXPENDITURES FOR PERSONS OF DIFFERENT AGES AND SEXES FOR ARTICLES PURCHASED FOR USE BY A SPECIFIC INDIVIDUAL

(As Shown by the Budgets of 140 Families in the Cotton-Mill Villages of South Carolina for a Twelve-Month Period Ending in 1917)

Age in Years	Male	Female	Age in Years	Male	Female
Under 1 . . . .	.11	.11	41 . . . .	.80	.44
1 . . . .	.13	.13	42 . . . .	.79	.43
2 . . . .	.16	.16	43 . . . .	.79	.41
3 . . . .	.17	.17	44 . . . .	.78	.40
4 . . . .	.19	.18	45 . . . .	.78	.38
5 . . . .	.20	.19	46 . . . .	.77	.37
6 . . . .	.22	.21	47 . . . .	.76	.36
7 . . . .	.24	.23	48 . . . .	.76	.35
8 . . . .	.26	.25	49 . . . .	.75	.35
9 . . . .	.28	.27	50 . . . .	.74	.34
10 . . . .	.31	.30	51 . . . .	.73	.33
11 . . . .	.33	.33	52 . . . .	.71	.33
12 . . . .	.35	.37	53 . . . .	.69	.32
13 . . . .	.40	.40	54 . . . .	.67	.32
14 . . . .	.46	.44	55 . . . .	.64	.31
15 . . . .	.55	.48	56 . . . .	.62	.30
16 . . . .	.65	.57	57 . . . .	.61	.30
17 . . . .	.77	.60	58 . . . .	.60	.29
18 . . . .	.86	.61	59 . . . .	.58	.29
19 . . . .	.92	.63	60 . . . .	.57	.28
20 . . . .	.95	.63	61 . . . .	.56	.28
21 . . . .	.96	.63	62 . . . .	.55	.27
22 . . . .	.98	.62	63 . . . .	.54	.27
23 . . . .	.99	.62	64 . . . .	.53	.27
24 . . . .	1.00	.61	65 . . . .	.52	.26
25 . . . .	1.00	.60	66 . . . .	.51	.26
26 . . . .	.99	.60	67 . . . .	.51	.26
27 . . . .	.97	.59	68 . . . .	.50	.26
28 . . . .	.95	.59	69 . . . .	.49	.26
29 . . . .	.94	.58	70 . . . .	.49	.26
30 . . . .	.92	.58	71 . . . .	.48	.26
31 . . . .	.91	.57	72 . . . .	.47	.25
32 . . . .	.89	.55	73 . . . .	.47	.25
33 . . . .	.88	.54	74 . . . .	.46	.25
34 . . . .	.87	.52	75 . . . .	.46	.25
35 . . . .	.85	.50	76 . . . .	.45	.25
36 . . . .	.84	.49	77 . . . .	.45	.25
37 . . . .	.83	.48	78 . . . .	.44	.25
38 . . . .	.82	.47	79 . . . .	.44	.25
39 . . . .	.82	.46	80 . . . .	.43	.25
40 . . . .	.81	.45			

apparently with considerable care.<sup>1</sup> The present writers, however, were in doubt concerning two points. They were uncertain as to whether the Atwater scales were or were not strictly applicable to the class of people found in the cotton-mill villages. They were also not sure that food *purchased* for persons of different sexes and ages would vary in exactly the same proportions as do the *calorific needs* of these persons. They therefore decided that inasmuch as a large mass of carefully collected food records were available for study it might be well to test these points.

The Atwater system assumes the consumption of a normal man working at moderate muscular work to be unity, and rates the consumption of all other persons as relative thereto. Thus, a man at a sedentary occupation or a woman at moderately active work is given as consuming 0.8 of the consumption of an adult man at moderate muscular work, and hence either of these persons is referred to as 0.8 of an "adult male unit."

With records on hand of the food consumption of about 14,000 different dietary groups<sup>2</sup> of persons, each group being of known composition as to numbers, age, and sex, it appeared feasible to ascertain mathematically whether or not the Atwater scales were actually illustrative of the demands of the cotton-mill villagers for food. The actual process used will be given in some detail in the *Quarterly Publications of the American Statistical Association* for September, 1921, and it seems therefore unnecessary to present here the description of the somewhat involved and decidedly laborious procedure by which the relative amounts of food used by persons of both sexes and various ages were determined. Suffice it to say the conclusions arrived at are derived from a careful and amply verified analysis of the expenditures for food of 1,500 selected families in the South Carolina cotton-mill villages. It can be said with confidence that they represent with a rather high degree of accuracy the relative average food expenditures of the population studied.

<sup>1</sup> See *Farmers' Bulletin*, No. 142 of the United States Department of Agriculture, by W. O. Atwater, Ph.D., pp. 32-36.

<sup>2</sup> The term *dietary group* is used to cover all persons partaking of a common food supply—usually a family with perhaps boarders or visitors in addition.

The results as ascertained showed that the relative food consumption in the mill villages did not quite follow the Atwater scales

TABLE II  
FINAL SCALES OF FAMMAINS

(Derived from Food Records of 1,500 Families Collected in 1917 from Residents of Twenty Cotton-Mill Villages of South Carolina)

Age in Years	Male	Female	Age in Years	Male	Female
Under 1.....	.278	.265	41.....	.1.000	.858
1.....	.302	.289	42.....	.1.000	.858
2.....	.348	.335	43.....	.999	.857
3.....	.381	.371	44.....	.997	.854
4.....	.410	.403	45.....	.994	.851
5.....	.435	.427	46.....	.991	.848
6.....	.460	.447	47.....	.988	.845
7.....	.483	.463	48.....	.985	.842
8.....	.506	.478	49.....	.982	.839
9.....	.531	.492	50.....	.979	.836
10.....	.557	.517	51.....	.976	.833
11.....	.592	.541	52.....	.973	.830
12.....	.639	.576	53.....	.970	.827
13.....	.694	.615	54.....	.966	.824
14.....	.769	.660	55.....	.962	.821
15.....	.837	.715	56.....	.958	.818
16.....	.900	.760	57.....	.955	.815
17.....	.935	.795	58.....	.952	.812
18.....	.965	.820	59.....	.949	.809
19.....	.983	.835	60.....	.946	.806
20.....	.991	.845	61.....	.943	.803
21.....	.998	.853	62.....	.940	.800
22.....	1.000	.858	63.....	.937	.797
23.....	1.000	.858	64.....	.935	.794
24.....	1.000	.858	65.....	.933	.792
25.....	1.000	.858	66.....	.931	.790
26.....	1.000	.858	67.....	.929	.788
27.....	1.000	.858	68.....	.927	.786
28.....	1.000	.858	69.....	.925	.784
29.....	1.000	.858	70.....	.923	.782
30.....	1.000	.858	71.....	.921	.780
31.....	1.000	.858	72.....	.919	.778
32.....	1.000	.858	73.....	.917	.777
33.....	1.000	.858	74.....	.915	.775
34.....	1.000	.858	75.....	.913	.774
35.....	1.000	.858	76.....	.911	.772
36.....	1.000	.858	77.....	.909	.771
37.....	1.000	.858	78.....	.907	.770
38.....	1.000	.858	79.....	.905	.769
39.....	1.000	.858	80.....	.903	.768
40.....	1.000	.858			

either as regards age or sex. However, it was proved statistically that the difference in the ratios was not due to one being expressed

in calories and the other in money value. In fact, it was shown with a reasonable degree of conclusiveness that for a given class of citizens there is no change in the cost per calorie of the food supply, no matter what the age or sex composition of the family. In other words, for a given group of people of approximately like income the *relative* food requirements of persons of different ages and sexes

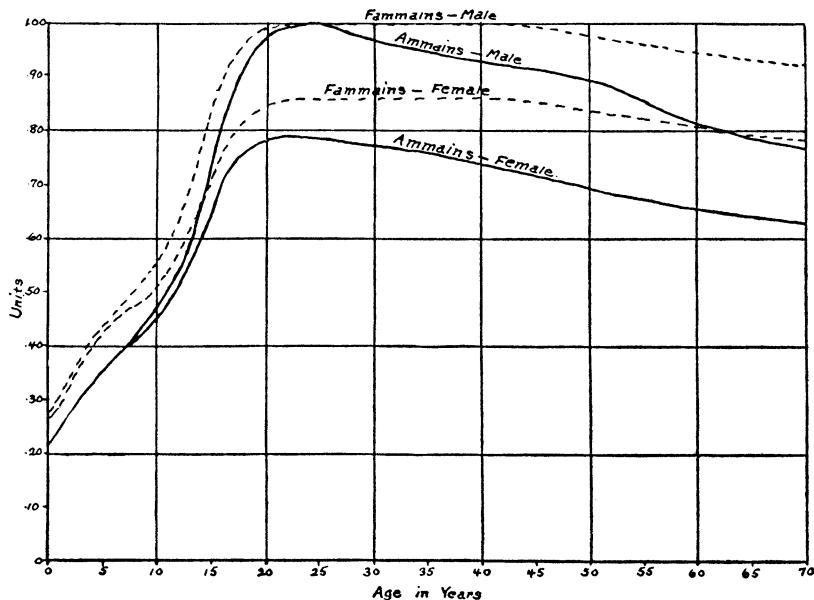


FIG. 1.—Ammain and Fammain scales, representing relative expenditures for all purposes and for food only of persons differing in age and sex. Derived from budgets of families residing in 1917 in various cotton mill villages in South Carolina.

vary in identical fashion, whether these requirements were originally measured in terms of calories or of money value.

Since the Atwater scales, however, were in terms of calories while the curves needed for the purposes at hand were those representing food expenditures in money, it was deemed best to give a distinctive name to the unit employed. It has therefore been called "fammain," this word being a condensation of the phrase "food for adult male maintenance." The unit is defined for any given class of people as *a demand for food of a money value equal to*

that demanded by the average male in the given class at the age when the expense for his food reaches a maximum.

A statistical study of the food consumption of different income classes among the mill-workers indicates that the *relative* effects of age and sex upon the value of food consumed do not vary noticeably with changes in income, although, of course, the actual amount expended increases all along the line as income grows larger. There apparently exists, therefore, a single scale for each sex which is approximately correct for all incomes. If this is true, it is a most important fact, since it means that the same fammain scales are appropriate for all classes of the population without regard to occupation or place of residence. An apparent verification of this theory is brought out by Professor Horace Secrist's discovery that in an Evanston, Illinois, restaurant, women spent 86.8 per cent as much per meal as did the men.<sup>1</sup> The ratio as shown by the fammain scale for the mill villages of South Carolina is 85.8 per cent. These results are so close as to be surprising.

The practical mode of using the fammain scale as a means of rating dietary groups according to food requirements is shown below.

TABLE III  
COMPUTATION OF THE NUMBER OF FAMMAINS IN THE DIETARY GROUP HEADED BY JAMES BOYD

Name	Age	Sex	Relationship to Head of Group	Number of Fammains
Boyd, James.....	28	Male	Head	1.000
Boyd, Dora.....	26	Female	Wife	.858
Boyd, Joseph.....	7	Male	Son	.483
Boyd, Charles.....	5	Male	Son	.435
Boyd, Lucy.....	3	Female	Daughter	.371
Boyd, Alma.....	1	Female	Daughter	.289
Boyd, Mary.....	49	Female	Mother	.839
Richards, Jesse.....	26	Male	Boarder	1.000
Mathers, Cora.....	18	Female	Boarder	.820
Scott, Henry.....	16	Male	Visitor	.900

Total fammains in dietary group = 6.995

Total weekly food cost = \$17.25

$$\text{Weekly food cost per fammain} = \frac{\$17.25}{6.995} = \$2.47$$

<sup>1</sup> See the *Quarterly Publications of the American Statistical Association*, for September, 1910, p. 470.

The practical importance of the idea of reducing dietary groups to equivalent fammains is very great. The following examples will illustrate a few of the cases in which the device proves its utility:

1. The profit or loss on boarders can be readily figured. The food cost of Cora Mathers' board is  $\$0.82 \times \$2.47$  or  $\$2.02$ . If she pays  $\$3.50$  weekly for board, Mrs. Boyd has  $\$3.50 - \$2.02$ , or  $\$1.48$ , to cover the cost of fuel, table linen, etc., and to pay for her work.

2. Suppose that an investigation shows the average expense for food to be  $\$0.075$  per 1,000 calories as was indicated for southern textile workers; then the food supply of this family presumably contains about  $\frac{\$2.47}{\$0.075} = 33,000$  calories weekly or about 4,700 calories daily for each fammain (or adult male equivalent).

3. If the average family should be found to spend  $\$2.50$  per fammain for a week's food supply, then the family of James Boyd, if its  $\$2.47$  food supply is a sound criterion, seems to be about typical, and hence cannot be classed with either the best- or the poorest-fed families of the village.

The fammain scales, therefore, are in themselves most useful, but in order to be of aid in classifying the population according to income it is necessary that they be combined with the previously described scales representing expenditures for individual needs. In making this combination, each scale was weighted in proportion to the total money spent for the respective purposes. The new scales resulting from the combination will hereafter be assumed to represent approximately the proportional demands upon income made by persons of each sex at every year of age.

It is true that, in these scales, a number of important items of expenditure such as rent, fuel, light, and furniture are omitted from consideration; yet, after all, these items form but a relatively small fraction<sup>1</sup> of the total living expenses of mill families. Besides, there is no especial reason to suppose that they are apportioned in a materially different way than are the outlays for food, clothing,

<sup>1</sup> House rents in the mill villages are very low, rarely amounting to over 5 per cent of the family income.

etc. Hence, the combination scales are believed roughly to represent the relative average requirements for all purposes of persons of different sexes and various ages.

TABLE IV  
FINAL SCALES OF AMMAINS

(Derived from Complete Budgets of 140 Families and from Food Records of 1,500 Families Collected in 1917 from Residents of Twenty Cotton-Mill Villages of South Carolina)

Age in Years	Male	Female	Age in Years	Male	Female
Under 1....	.220	.220	41.....	.928	.735
1.....	.241	.241	42.....	.925	.731
2.....	.281	.281	43.....	.922	.727
3.....	.306	.306	44.....	.919	.723
4.....	.332	.332	45.....	.916	.718
5.....	.352	.352	46.....	.912	.713
6.....	.375	.375	47.....	.908	.708
7.....	.397	.396	48.....	.904	.703
8.....	.419	.412	49.....	.899	.698
9.....	.442	.429	50.....	.894	.693
10.....	.470	.451	51.....	.888	.689
11.....	.499	.481	52.....	.881	.685
12.....	.537	.514	53.....	.873	.681
13.....	.590	.553	54.....	.804	.677
14.....	.657	.596	55.....	.854	.673
15.....	.736	.648	56.....	.844	.669
16.....	.812	.705	57.....	.834	.666
17.....	.876	.739	58.....	.825	.663
18.....	.928	.760	59.....	.818	.660
19.....	.960	.776	60.....	.812	.657
20.....	.976	.783	61.....	.807	.654
21.....	.986	.789	62.....	.802	.651
22.....	.992	.790	63.....	.797	.648
23.....	.996	.790	64.....	.792	.645
24.....	1.000	.788	65.....	.788	.642
25.....	1.000	.786	66.....	.784	.639
26.....	.996	.784	67.....	.780	.636
27.....	.990	.782	68.....	.776	.634
28.....	.984	.780	69.....	.772	.632
29.....	.978	.778	70.....	.768	.630
30.....	.972	.776	71.....	.764	.628
31.....	.967	.773	72.....	.760	.626
32.....	.962	.770	73.....	.757	.625
33.....	.957	.767	74.....	.754	.623
34.....	.952	.763	75.....	.751	.622
35.....	.948	.759	76.....	.749	.620
36.....	.944	.755	77.....	.747	.619
37.....	.940	.751	78.....	.745	.618
38.....	.937	.747	79.....	.743	.617
39.....	.934	.743	80.....	.741	.616
40.....	.931	.739			

In order to make these scales conveniently usable, it is necessary to choose a suitable unit and give it an approximate name. The definition of the unit and the name chosen for it are both derived similarly to those for the scales showing consumption of food only. The appellation given to the unit representing all expenditures is the "ammain," the word being an abbreviation of the phrase, *adult male maintenance*. The unit is defined as *a gross demand for articles of consumption having a total money value equal to that demanded by the average male in the given class at the age when his total requirements for expense of maintenance reach a maximum*. This is equivalent to saying that the absolute expense figure at the crest of the male curve is taken as unity and that all the other quantities are considered as fractions of that base.

The ammain, then, is strictly a relative unit; and ammain curves derived for any class of the population in any section of the country are, therefore, not likely to differ widely from each other. In fact, it is probably true that correctly calculated ammain curves would be nearly identical for various sections of the working class. It is not unlikely, however, that the curves representing the demands of the poor may differ slightly from those representing the requirements of the richer families. The main reason for suspecting such a possible difference is that, according to observation, the women among the well-to-do classes of the population buy more expensive attire than do the men, while, on the contrary, the women of the cotton-mill villages spend for their clothing about three-fifths as much as do their husbands. When, however, the relatively small weight which clothing has in the total family budget is considered, it scarcely seems possible that this relative difference in the cost of women's attire in the various social classes can result in any material change in the ammain scales.

Investigation alone will show whether or not it is necessary to derive a separate pair of ammain scales for each occupation in each locality, but the probabilities are that a very few such scales, none of them differing widely, would suffice to cover all of the families of the United States with but a narrow margin of error. In fact, a pair of ammain scales, worked out upon a basis of average consumption throughout the year by families of all classes in all

localities, could probably be used for any class of families whatever without introducing sufficient error to vitiate in the slightest degree the practical conclusions obtained by the use of the scales.

The practical application of the ammain scales derived for the mill-working population is shown by the following illustrations:

TABLE V

## COMPUTATION OF THE NUMBER OF AMMAINS IN THE FAMILY OF JAMES BOYD, COTTON-MILL WORKER

Name	Age	Sex	Relationship to Head of Family	Number of Ammais
Boyd, James.....	28	Male	Head	.984
Boyd, Dora.....	26	Female	Wife	.784
Boyd, Joseph.....	7	Male	Son	.397
Boyd, Charles.....	5	Male	Son	.352
Boyd, Lucy.....	3	Female	Daughter	.306
Boyd, Alma.....	1	Female	Daughter	.241
Boyd, Mary.....	49	Female	Mother	.698

$$\begin{aligned} \text{Total ammais in family} &= 3.762 \\ \text{Total annual family income} &= \$900 \\ &\quad \$900 \\ \text{Annual income per ammain} &= \frac{\$900}{3.762} = \$239 \end{aligned}$$

The advantages of reducing family income to a per ammain basis are obvious and striking. By this process all families are made readily comparable as to income, entirely regardless of their respective age and sex compositions or of the number of persons composing them. This mode of procedure substitutes precise for haphazard methods, brings order out of chaos, and, in fact, offers the first plan which really permits of the income classification of all of the families in any locality with any reasonable degree of precision.

The authors are far from asserting that the ammain scales here-with presented are the final word in that line. They would not even contend that they are absolutely correct for the cotton-mill workers of South Carolina, though they do believe that they approximate the true condition of affairs for that class. On the contrary, they believe it highly desirable to derive ammain scales for as many classes of the population as possible, in order to learn what variations actually occur under different circumstances. They

are, however, most firmly convinced that either the ammain system of measurements, or something very similar in nature, should promptly be brought into general use in all cases in which there is a necessity for classifying the population upon an income basis.

It is true, presumably, that scales derived from a study of South Carolina cotton-mill workers when applied to other groups of our population would not give as accurate results as would scales specifically constructed for the population in question. However, the chances are that the actual errors thus arising would be so trivial that they might be safely ignored. It would, therefore, appear to be perfectly safe for private investigators who are financially unable to derive scales on their own account to complete their income studies by the aid of the ratios here presented.

The suggestion may be ventured that the Bureau of Labor Statistics, the Treasury Department, or some other interested branch of the government derive official ammain scales based upon an average representing all classes of the population. It is believed that such an official scale would rapidly find numerous uses. For example, logic would seem to insist upon the early reconstruction of our income-tax statistics according to this plan. The number of ammains and the income per ammain should be computed for each taxed family, and the incomes per ammain should then be properly classified. In this way it would be possible to obtain a true picture of the distribution of incomes among the taxed section of the population. The Bureau of Labor Statistics by the adoption of this device could materially simplify all of the problems connected with studies of the cost of living. Wage boards and arbitration committees everywhere might find it helpful in their work.

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